Australian Bureau of Statistics

1352.0.55.157 - Research Paper: Quadratic Optimisation for Table Balancing in Official Statistics (Methodology Advisory Committee), June 2016

Latest ISSUE Released at 11:30 AM (CANBERRA TIME) 14/09/2016 First Issue

Summary

Main Features

MAIN FEATURES

National Accounts and other statistical outputs frequently require “balancing” or “benchmarking”: adjusting estimates to satisfy internal consistency constraints and/or to reconcile information from multiple sources. Mathematical optimisation techniques such as weighted least squares balancing (WLS) are used for this purpose by other agencies and offer advantages over current ABS methods. The additional flexibility of WLS methods will improve the production and quality of National Accounts estimates, by making better use of data quality information and saving time currently spent in manual processes.

Ideally, weighting of adjustments would be based on the variance of the unbalanced estimate. When variance data is unavailable (e.g. non-survey sources), a fall-back method is required. This paper offers arguments for fall-back weighting according to the magnitude of unadjusted value (as opposed to squared magnitude).

The literature on WLS balancing has often approached these problems with the goal of minimising changes to levels and/ or changes to time series movements. This paper considers the problem of producing a maximum likelihood estimator (MLE) for the true data values, and shows that for certain important cases, WLS movement- or level-preservation is in fact equivalent to a MLE-based solution. It also offers a method, usable in both MLE- and movement-preservation frameworks, for reducing bias in forward-series estimates for balanced time series.

WLS balancing requires setting weighting parameters that indicate expected error behaviour. This has generally been done through numerical models which require parameters to be set subjectively, e.g. through estimation by subject matter experts. This paper suggests an alternative way for setting parameters: by framing balancing as a MLE problem, a MLE approach can be applied to estimating these parameters, reducing subjectivity and need for manual involvement in the process.

This paper then extends the MLE approach to give a WLS method covering cases where both movements and levels are of interest, and shows that a previously-published WLS method for handling such cases is *not* equivalent to the MLE solution.

This paper also discusses options for balancing diagnostics, for handling nonlinear constraints with software that only supports linear constraints, and for dealing with very large problems whose size may present computational difficulties.

About this Release

National Accounts and other statistical outputs frequently require “balancing” or “benchmarking”: adjusting estimates to satisfy internal consistency constraints and/or to reconcile information from multiple sources. Mathematical optimisation techniques such as weighted least squares balancing (WLS) are used for this purpose by other agencies and offer advantages over current ABS methods. The additional flexibility of WLS methods will improve the production and quality of National Accounts estimates, by making better use of data quality information and saving time currently spent in manual processes.